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ABSTRACT

This study was designed to examine how teachers' beliefs and values influence the successful integration of microcomputers into the curriculum. Semi-structured interviews with 20 teachers were conducted in elementary, middle, and high schools in one urban and one suburban district in New York State and responses were categorized into four groups: (1) Progressive Practice and Successful Technology Integration; (2) Progressive Practice and Technological Ambivalence; (3) Traditional Practice and Technological Reluctance; and (4) Progressive Practice and Lack of Opportunity. Each group was examined in terms of classroom practices and educational objectives, teachers' perceptions of themselves and their students, conceptualizing the relationship between technology and education, integrating technology into the curriculum, how teachers got involved with technology, facilitating factors, deterring factors, and envisioning future classroom environments. Results indicate that unless teachers are personally ambivalent about computers or have lacked the opportunity to get involved with computer technology, their educational beliefs play an important role in how they choose to appropriate and make use of technologies in their classrooms. (14 references) (DB)

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Teachers' Beliefs and Technology Integration: Different Values, Different Understandings

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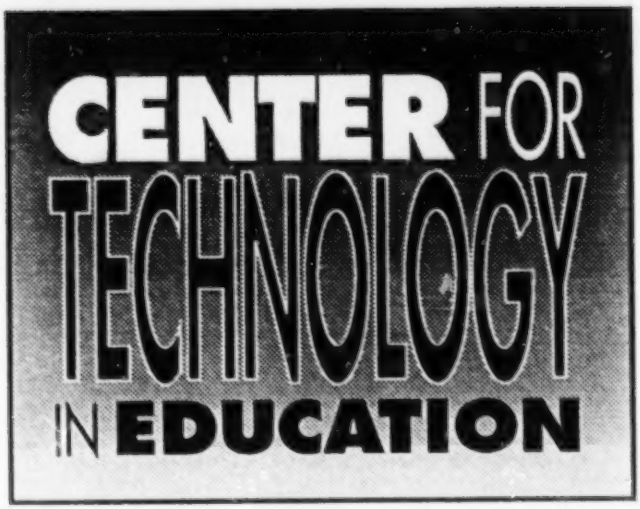

Technical Report No. 6

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August 1990

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TEACHERS' BELIEFS AND TECHNOLOGY INTEGRATION: Different Values, Different Understandings

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INTRODUCTION

The goal of this study was to explore teachers' thinking on how and why they do or do not use information technologies in their classrooms. Are there discernible patterns in how teachers talk about their classroom practices and educational objectives that appear to either facilitate or detract from the integration of technology into their curricula? What, in turn, can we cull from this information that will enable teachers, schools, and districts to integrate technology into educational environments in deep and meaningful ways?

Background

Studies on the effective adaptation of computers into the curriculum have focused on what teachers need to successfully make use of microcomputer technology (Hess & Miura, 1984, 1986; Martin, 1987; Sheingold, Martin, & Endreweit, 1987). We know, for example, that teachers require training not only in how to use the technology, but in how specific applications can be integrated into ongoing curriculum activities (Hawkins, 1990; Martin, 1987; Schofield & Verban, 1988; Watt & Watt, 1986). In addition, we have learned that teachers need support from department heads, administrators, and district personnel in order to plan and schedule lessons and review materials that will help them develop and implement successful uses of computer technology (Hawkins & Sheingold, 1986; Loucks & Hall, 1982; Martin, 1987; Wiske, 1987). Finally, we know that teachers need an array of resources ranging from technical support (e.g., how to use hardware and software, how to diagnose equipment problems) to adequate information about existing applications in order to be able to make meaningful use of computer-based technologies (Hawkins, 1990).

Although there have been studies suggesting that teachers adopt innovations in light of their goals and beliefs, this research has not been extended to examine how teachers' beliefs and values influence the successful integration of microcomputers into the curriculum. For example, there is substantial literature on teachers' pedagogical judgments and decision making in general (e.g., Clark & Peterson, 1986; Shavelson, 1983; Shavelson & Stern, 1981; Shulman, 1987), yet little is known about the role that teachers' pedagogical beliefs and values play in shaping their relationship to information technologies as they function in the instructional context. We believe that such an investigation is useful in laying the groundwork for supporting new learning practices.

The authors would like to express their thanks to the teachers and administrators who participated in this study.

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METHODOLOGY

Overview

We conducted interviews with twenty teachers who either used or did not use computer technologies in their classroom. The interviews were conducted in elementary, middle, and high schools in two districts in New York State. One district was urban, located in Brooklyn, with a largely working-class, racially diverse student body. The other district was suburban, located in affluent Westchester county, with a largely white, upper-middle-class population of students.

Both districts had made special efforts to promote the use of information technologies in their schools, including hiring district computer coordinators, conducting training workshops for teachers, and bringing in outside consultants to advise on the development of their technology programs. More recently, these districts have undertaken special efforts to move away from the lab-based computer literacy model of technology, toward the integration of computer applications into the curriculum.

Sample

Our initial contact with both sites was through their district computer coordinators. We explained that we were interested in interviewing two groups of teachers. First, we wanted to talk to teachers who had successfully integrated information technologies into the ongoing work of their classrooms. Our interest in this group of teachers reflected a particular point of view concerning the ways information technologies coulld be most effectively used in educational settings for high-quality teaching and learning. While we were aware that there were practitioners who used information technologies in a myriad of ways, we wanted to speak with teachers who did not use technology to replace large segments of their curriculum, but rather used it as an integral part of their teaching to enhance, supplement, and enlarge what they could do in particular subject areas. Second, we asked to interview teachers who had had the same opportunities as their colleagues to get involved with using information technologies but had elected not to do so.

In the suburban district, the computer coordinator arranged for us to carry out interviews in two elementary schools—the junior high and the high school. In this district, we spoke with three teachers who had elected not to use computers and six teachers who were deeply involved in using information technologies. In the urban district, the computer coordinator arranged for us to contact the principals at two elementary schools and one junior high school, and it was through the principals or assistant principals that we arranged to interview teachers at these three locations. In this district, we spoke to six teachers who were not using computers in their classrooms and five who were.

Our contacts in these districts selected teachers from a variety of disciplines, including language arts, computer science, math, biology, social studies, history, art, special education, and media arts.

The teachers were experienced practitioners; there were only two individuals who had been teaching for less than ten years. The high-tech teachers had been practicing an average of 18.2 years, with a range of 6 months to 36 years. The low-tech teachers who were not using information technologies had been practicing an average of 18.7 years, with a range of 3 to 32 years.

Interview Guide

With both groups of teachers, we used a semi-structured interview format in which they were asked to discuss a number of questions that fell under four headings: (1) general classroom practices and educational objectives; (2) the relationship between technology and education; (3) technology in the classroom; and (4) classrooms of the future. All interviews were tape recorded and were approximately 45 minutes in length.

The interview guides for high-tech and low-tech teachers differed only in the questions we asked in the third section. For those teachers involved with technology, we asked them to describe how they were currently using computers in their classrooms, how they came to be involved with using computers, and what factors facilitated or deterred their involvement. With those teachers who did not use computers, we explored why they had elected not to do so as part of their current practices.

Data Analysis

The goal of the data analysis was to determine whether there were discernible patterns in teachers' pedagogical beliefs and practices that appeared to either facili-

tate or detract from the integration of technology into their classroom practices. For this purpose, we paid close attention to the themes that emerged in different segments of the interviews for high-tech versus low-tech teachers. Each interview was transcribed and themes were recorded and tabulated on a question-by-question basis.

The analyses focused on five general topics. First, we explored whether high-tech versus low-tech teachers differed in terms of their general classroom practices and educational objectives. Did these teachers employ progressive educational practices, such as the use of inquiry and discovery skills, project-oriented work, and hands-on activities? Or did these teachers' practices reflect a more traditional approach to education, such as teaching from the textbook or teaching to the test? Second, we looked at teachers' perceptions of themselves and their students. Did they view themselves as learners? Did they see teaching as an interactive process in which they both conveyed information to and learned from their students? Had their practices changed over time? Third, we examined how these two groups of teachers conceptualized the relationship between technology and education. Fourth, we looked at how the high-tech teachers went about integrating technology into their curricula and what factors facilitated or detracted from this process, and we explored the reasons why the low-tech teachers opted not to use information technologies. Finally, we examined how these two groups of teachers envisioned future classroom environments. We identified themes in each of these topic areas and then examined the data to determine whether there was a relationship between teachers' general educational objectives and their beliefs and practices regarding the use of information technologies in their classrooms.

FINDINGS

Based on this analysis, we found that the teachers we interviewed could be grouped under four general headings. First, the high-tech teachers represented a fairly homogeneous group with respect to their pedagogical beliefs and practices. These teachers were from both districts and, despite the very different circumstances in which they were teaching, they were a group of practitioners who had used their student-centered goals and beliefs (e.g., inquiry methods, collaborative learning, hands-on practices) to stimulate the creative use of computer-based technologies in their classrooms.

The low-tech teachers, on the other hand, tended to be more heterogeneous as a group. They could be characterized by three different orientations toward the use of information technologies. First, there were teachers whose educational beliefs were student-centered, like those of the high-tech teachers, but they were reluctant to use information technologies because of personal fears and inhibitions. Second, there were teachers whose classroom practices and educational objectives were much more traditionally based. These teachers were reluctant to use computers for two principal reasons: On the one hand, they feared that the technology might alter their relationship of control and authority with their students; on the other, they felt overwhelmed by the number of city-mandated requirements and, thus, that they did not have time to spare for additional activities. Finally, there were teachers whose practices tended to be student-centered and who would have liked to use computers in their classrooms, but either the equipment was not available or they had problems scheduling time in the computer lab.

By paying particular attention to teachers' pedagogical beliefs, we will profile these four groups of teachers in separate sections: Progressive Practice and Successful Technology Integration; Progressive Practice and Technological Ambivalence; Traditional Practice and Technological Reluctance; and Progressive Practice and Lack of Opportunity.

Progressive Practice and Successful Technology Integration

Classroom Practices and Educational Objectives

All of the high-tech teachers were skilled professionals who were engaged in quality educational practices such as collaboration, project-oriented work, and hands-on activities with their students. They discussed wanting to instill a sense of curiosity and a desire to learn in their students. Several of the teachers, particularly those involved in special education, chose to employ methods that were geared toward the needs of individual students, while others emphasized collaborative work. There was uniform agreement among teachers from both districts that students

needed to be able to think for themselves and in a critical fashion. These practitioners down played the teaching of facts in favor of an inquiry-based or discovery mode of learning among their students. For example, a teacher from the suburban district defined her objectives in the following terms:

> Probably our primary goal in both subject areas [math/science] is to instill a sense of curiosity into the kids—to get them to want to find things out. So a goal would not be to give out a lot of information—that's not one of the things we're after. We're after getting kids to want to find out answers and trying to equip them with the best possible tools to find those answers.

Teachers' Perceptions of Themselves and Their Students

This high-tech group of teachers viewed all students as potential learners who had different styles of learning and different learning requirements. As one urban teacher said,

> I believe that any child can learn anything in this world if they set their mind to it. No child is limited by his intelligence. A child does not necessarily have to learn by one modality. A child can learn by other modalities. If a child cannot learn from a printed page, they can learn aurally or visually.

These teachers also described themselves as learners and talked about their teaching practices as having changed over time. In particular, they stress the importance of developing and changing in response to their students' needs. Many of these teachers discussed abandoning their initial use of more traditional methods, such as teaching from the textbook, in favor of engaging their students in project-oriented and group-based activities. In addition, a number of these teachers pointed out that with experience comes an increase in self-confidence. As a result, they tended to worry less about creating the "perfect" lesson and placed more trust in solving problems with their students. As one suburban teacher said:

> How have I evolved as a teacher? I'm not so worried any longer that something is glitch-free. We'll work it out together. The old me wasn't free enough to take that chance.

Conceptualizing the Relationship Between Technology and Education

Not surprisingly, these teachers viewed the relationship between technology and education as an extremely viable and productive one. They believed that technology was most valuable when thought of as a tool that functioned as a facilitating resource to support and enhance activities that were currently taking place in the classroom. In their view, technology and the curriculum mutually influenced and enhanced each other. One of the urban teachers who was working with a number of different technologies described the relationship between technology and education in the following terms:

> I don't see technology as a replacement for the teacher in the front of the room. I use computers as part of the curriculum, to enhance it, to put things together. The camera enhances what's going on . . . to communicate through moving pictures. When we put together a video, we have to mix music, etc. Technology is used extensively, but it cannot exist by itself.

In addition to regarding technology as a facilitating tool, many of the teachers in this group spoke about technology as an inevitable fact of contemporary existence; as a result, they strongly believed that in order for their students to be competitive in the world they had to be comfortable with using information-based technologies. As a junior high school computer teacher from the urban district said,

> I really feel that everybody is going to be using computers, either in their job or somehow in their life in the future. The youngsters today have to be comfortable with that. They have to be able to use these computers to their best advantage.

Integrating Technology into the Curriculum

Of the five urban district teachers we interviewed, three had access to two or more computers in their classrooms and two took their students to a lab to use the machines. In the suburban district, three teachers had two or more computers in their classrooms and three took their classes to computer labs.

Regardless of whether they used computers in a lab or classroom setting, all of these teachers had

worked hard to integrate the technology into their ongoing curriculum. They used technology as an integral part of their regular classroom work, and the software they worked with was designed to enhance and/or facilitate specific curricular objectives that were already in place. For the most part, these teachers were using tool-based software that enabled their students to undertake creative writing projects, publish newspapers, create magazine covers, explore math problems through the use of spreadsheets, and pursue science questions with microcomputer-based laboratories.

A special-skills teacher from the suburban district illustrated how she was collaborating with classroom and art teachers to make the computer an integral part of the fifth grade curriculum in her school:

> Two of our fifth grades, as part of our local history project, have been studying architecture and they had the children, along with their art teacher, take pictures of their homes. They're making clay models of their homes and then up here [resources room] they've been using Logowriter to draw their homes. They've been creating programs that will at the touch of a button create their house. Now that we have the color printer on loan for a week, they've been printing them out. They write a paragraph [using the Bank Street Writer] on the flip side about how their house matches their architectural styles. There are a lot of possibilities for extension that we are just beginning to see and I think we've come a long way in a year.

In another example, a computer resource teacher from the urban district ran a class that was designed to help students create publications based on work they were doing in their classes or as part of extra-curricular projects:

> I have a group that meets with me at 8:00 in the morning. We're not due in until 8:40, but I have children who come at 8:00 in the morning. They're learning desktop publishing. We're publishing a newspaper that one of the other classes is writing, and we are publishing a science bulletin and anything else that students are writing. We use PageMaker and the Macintosh computer and the LaserWriter to make a professional publication. These kids love it...they want extra time and they do enjoy it.

When these teachers used content-based software, they tended to avoid drill and practice or CAI software and worked with programs that supported their pedagogical beliefs. Not surprisingly, the particulars of what they were doing varied depending on the subject matter they were teaching. For example, in a high-school math class the teacher tied the use of the computer into helping his students understand the principles that underlay quadratic functions. As he said:

> I tie it [the computer] into discovery. For instance, if I was teaching a tenth grade class the graphing of quadratic functions . . . and I say let's go to the software and do the graph. Then we look at it and I say, "What seems to happen?" They notice that it gets fatter and skinnier and so on, and then we work on that. We form generalizations and they draw their own conclusions.

In at least two instances, teachers chose to use technological applications (e.g., *The Voyage of the Mimi*) that promoted the meaningful integration of technology across curriculum areas. As one of the urban teachers explained:

> For me the *Mimi* can be an entire day's lesson. I can do reading, social studies, science, math. For example, I did Celsius and Fahrenheit [today]. We used the computer [the temperature probe] for measuring and we did the conversion of Celsius and Fahrenheit, we watched the videos, we had the questions down, we did the vocabulary. This is a holistic approach, every subject area is being taught within one curriculum framework.

In addition to the specifics of what they were doing with information technologies, there was widespread belief among teachers from both districts that the use of technologies could expand students' horizons and make learning more fun and meaningful. They also claimed that using technology had enabled them to make some desired changes in their teaching. Specifically, they spoke of having more time to help individual students; they said that their teaching could take on a new quality (e.g., more process-oriented than content-oriented); and they spoke about the fact

that technology could help them implement desired educational practices, such as small-group work and project-oriented activities.

How Teachers Got Involved with Technology

Although the teachers in this group had received different types of support for their involvement with computers, ranging from inservice training to university-taught courses, for the most part they were self-taught. They shared the characteristic of being highly motivated individuals who were eager to enhance their teaching skills by learning about a new technology that they saw as potentially valuable. All of these teachers were involved in using computers outside of school—either to do additional school-based work or as part of their personal lives.

The more specific reasons why these practitioners became involved with computers tended to vary across several dimensions. Four of the teachers, all of whom were practicing in the suburban district, said they began using information technologies in response to their students' growing interest in computers. In particular, they wanted to be informed—to be able to provide their students with knowledgeable answers to their questions. A junior high math teacher described his experience as follows:

> I thought unless I do something about this [about knowing computers], the kids are going to be having questions and I'm not going to know what's going on. So at the end of the year, I asked the principal and the district—I said I'd like to learn something about computers. They paid me for three weeks. I got a computer and locked myself in a room and taught myself. And what happened was there wasn't anybody else in the school who knew anything about it except the math aide. Eventually, the more I learned, the more people depended on me and I just sort of evolved into the person who knew.

Two other teachers from the suburban group described a situation in which "computers were more or less thrust on" them, but they both said that they quickly realized what valuable learning tools the machines could be for their students.

The teachers in the urban district had more diverse reasons for getting involved with information technologies. Two of the teachers spoke of their need to constantly change and modify what they did in order to keep their classroom practices exciting and interesting. A sixth grade classroom teacher described her interest in innovations this way:

> You have to understand that most old-time teachers are not willing to accept change, and this is where you are going to come across a problem, because most people who have been teaching as long as I have do not want to change. They are thinking in terms of retirement, thinking in terms of "I just want to get through the next couple of years in the same way," and I'm thinking—I get bored very easily, which is why I change constantly. I welcome anything. Every year I try something else for that reason.

These teachers took it upon themselves to approach the computer magnet teacher in their school and ask that computers be placed in their classrooms.

Two other teachers, also from the urban district, became interested because their own children had computers at home and they saw how excited they were by them.

Finally, another teacher had acquired an extensive background in a number of different technologies on his own, including computers, video, video editing, voice synthesizers, and photography. His school applied for and received a grant to become a magnet site and he was selected by the local school board to fill the magnet teacher position.

Facilitating Factors

All six of the teachers we interviewed from the suburban district talked about the importance of administrative and district-wide support for their technology programs. In particular, they mentioned their local teachers' institute, which provided a forum where teachers could share ideas, take courses, and write proposals to solicit money for training and curriculum development. In addition, the commitment on the part of this district to institute a technology program was exceedingly high, and outside computer experts were brought in to run a series of workshops and seminars with interested teachers. One of these teachers described the district's commitment in the following terms:

> The district went gung ho over [instituting technology-related programs]. We said, "We

want to do this and we want to do it the right way." We didn't jump into it and say, "Everybody's getting a machine." We said, "We have a five-year plan." We really did well, we had goals set up that we wanted to reach and we set a test of the rules. We tried it out on people who were interested, and then we spread it out a little bit as people got more comfortable, and then it sort of grew like a little monster. And it's still growing!

The suburban teachers also felt that they were treated as professionals—they spoke of being given a great deal of freedom to undertake their own initiatives, of the importance of having a number of resources at their disposal, including technical support and adequate supplies of hardware and software, and of being well-paid.

Teachers in the urban district were again more diverse. Although there clearly was district-wide support for the use of technology, teachers tended to answer this question by speaking about the immediate schools they were practicing in, their colleagues, or personal reasons. Factors that facilitated their involvement tended to vary from having a supportive mentor in the school who was available to troubleshoot and answer questions, to having a supportive administration, to simply overcoming personal resistance, such as an initial fear of the machine.

One junior high teacher described her experience in the following way:

> There was a teacher there in the beginning, just to help me out—to show me how to use computers. But now I go on my own and it's great. And if there's a problem I can feel my way around it, I can figure it out.

Deterring Factors

Despite the enthusiasm with which they embraced the use of information technologies, this high-tech group mentioned a range of specific factors that acted as deterrents in their learning about computer technology. These included having initially to learn on their own, having to overcome issues of fear and inadequacy, problems with hardware breaking down, a too small computer-to-student ratio, lack of time to develop new applications, and problems with having to purchase equipment through the guidelines established by New York City's Board of Education.

Envisioning Future Classroom Environments

Finally, when asked to envision an ideal classroom environment, these teachers imagined technology-rich environments in which the resources at their disposal would further enhance their students' work and their own teaching practices. Although the suburban teachers were more likely than the teachers from the urban district to acknowledge that they were working under fairly optimal circumstances, they also mentioned wanting additional resources, including VCRs, TVs, laserdiscs, and an adequate number of networked computers (preferably one for every student).

In addition to increased technological resources, the technology-using teachers from the urban district spoke of other changes they would make, including larger classrooms, smaller class sizes, phones in their rooms, and less bureaucracy.

Progressive Practice and Technological Ambivalence

Classroom Practices and Educational Objectives

There were three teachers who fell into this category: two were from the suburban district where one taught social studies at the junior high school and the other taught history at the high school; the third teacher taught math to ninth grade students in the urban district.

These teachers sounded very much like those in the high-tech group when they talked about their classroom practices and educational objectives. For example, the urban math teacher described his goals in the following terms:

> What I try to do is instill a feeling of satisfaction for the work that they've accomplished, for the work they can accomplish, and a healthy attitude toward learning in general. I really see mathematics as a very secondary thing that I do in school. My first job is to instill a feeling for learning, and a comfortable feeling, and a feeling that success is obtainable.

Similarly, the high school history teacher discussed the objectives he held for his students:

> I want them to understand how history works, so I get real far away from names and dates and things. I want them to come away with the joy of it. I guess I want them to come away with a sense of their own power, that they can figure out stuff. I want them to know what a historian does, which is different from knowing what history does.

Teachers' Perceptions of Themselves and Their Students

Like the practitioners in the high-tech group, these teachers said that their practices had changed and evolved over time. They spoke about becoming more relaxed and trusting their students; they discussed switching from more traditional methods to ones that were more interactive and interpretive; and they mentioned the importance of learning from their students and modifying their practices accordingly. In one case, a teacher made significant changes in his practices because of a conversation he had had with a valued student:

> I had this young man in the class who was a very interesting kid. . . . At the end of the second year he said to me, "You know this has been really wonderful, you can keep five balls in the air at once. When are you going to teach the students how to do it?" And that really made me think—it was a moment in my life where I thought, he's right. . . . So I began to try to find ways, first of plugging in primary source material into my classes. . . . I put together a bunch of primary source documents on Reconstruction and gave them to the kids and said, "O.K., what happened?" I broke them into groups of four and five and each had to write their history of Reconstruction. They all came up with different sorts of interpretations. And then I began, at the same time, to move toward doing more and more simulations. I guess I keep finding new things to do with my teaching.

Teachers' Reluctance to Use Information Technologies

Despite the fact that in terms of their pedagogical beliefs these practitioners sounded almost identical to the high-tech teachers, it became clear in the course of our interviews that their reluctance to get involved with computers stemmed from a deep-seated personal ambivalence about the technology itself.

For the math teacher this ambivalence took the form of an outright fear of the technology, along with a sense that he had no point of entry into a culture that was foreign to him:

> Unfortunately, in my own education, I predate all of the technology that's taught today. I have absolutely no background in computers and I'm very frightened of them, quite frankly. I've taken no steps to learn something which I feel I should have, but I haven't. . . . It's a whole new language, there are so many aspects of it which seem so strange and foreign to me. . . . I just don't know where to start at this point. It's a new language, it's a new culture, and I sort of feel like if I close my eyes it's going to go away.

The history teacher gave two reasons for his reluctance to get involved with computer technology. On the one hand, he felt that he lacked a certain technological know-how, and on the other, his first introduction to computers had proved to be a very negative experience.

> First, I think that there must be something in my makeup that makes me unable to visualize how to play with machines . . . I'm not handy. I can't change a tire. I can't do any of that stuff. Another—I don't know what order they're in, but they're all part of the same picture—is that my first experience here with computers was really bad. [A university professor came here and taught a seminar], it was all theoretical, we never *did* anything. The idea was that you would first understand all the theory.

Finally, despite the fact that for the social studies teacher word processing would greatly facilitate the professional writing that he did, he remained extremely reluctant to use computer technology.

> I write a great deal. I think that there are at least forty books that I've had published, and of course my publisher wants me to get a word processor. He says, "It will be so good for you, it'll be easier for you." I just can't seem to believe that that would be good for me. I just want to get in front of that typewriter.

Conceptualizing the Relationship Between Technology and Education

It was also apparent that the vision these practitioners had concerning the relationship between technology and education was affected by a lack of adequate examples concerning the use of computers in their respective disciplines. For instance, whereas the social studies teacher was enthusiastically involved in using a variety of "low-end" technologies with his students—including slides and prerecorded videos, as well as music and other recordings—he had not seen interesting examples of how he could use computers in his classes. In his own words:

> I find that the greatest thing in the world is being able to show motion picture events that the kids read in the textbook—they see the people themselves and what's going on, how they dress, how they talk, and how they move. I use these photo aids for practically every topic. . . . I use a great deal of music of the period—the lyrics of songs are a very important historical source. [These technologies] are a very crucial vehicle to teach, but I've never been able to see how I could use a computer.

The high school history teacher, whose characterization of technology as a "handmaiden" to the educational process sounded very much like the teachers in the high-tech group, had no vision, however, of how computers could be used to function in this capacity. And the math teacher's ideas concerning a successful partnership between technology and education was limited by his association of technology with the shop department.

Envisioning Future Classroom Environments

The fact that these teachers did not have adequate or exciting models for how technology could be used in their classrooms also influenced how they envisioned an ideal work environment. With the exception of the math teacher, who said, "There would probably be computers somewhere in the back, but I won't be there for it, the technology will be available for the kids," none of the teachers mentioned wanting information technologies in their classrooms. The social studies teacher was content with what he had, stating that he was well paid, had more than adequate resources, and was content to "have an audience four times a day" for which he could perform. The history teacher talked about wanting a larger physical space, as well as chairs that were mobile and blackboards that covered all four walls of the room. He also spoke about wanting to have specific low-end technologies, such as slide projectors, tape recorders, and video, so that he could call forth specific historical information.

Traditional Practices and Technological Refusal

Classroom Practices and Educational Objectives

There were four teachers who fell into this category, all of whom were working in the urban district. Two of the teachers taught fifth grade, one taught seventh grade social studies, and one taught ninth grade math. Their pedagogical beliefs and the practices they employed reflected a more conventional philosophy of education. They used traditional methods in their teaching, such as following the routines of the textbook or using a lecture format. A social studies teacher described his work in the following terms:

> My purpose is to follow, basically, the routines of the textbook that's given to us by our administration. I try to follow it as close as possible to the time schedule, making exceptions for holidays and stuff like that. We work on that each day and then we'll have some kind of test at the end of the week and that just reflects if the kids have really followed the lesson and done their homework studying.

In addition, these teachers placed less of an emphasis on the process of learning and more on their students' ability to pass city-wide examinations. As a fifth grade classroom teacher explained:

> In general I am very structured. I emphasize discipline first. The first thing teachers must have is control. I place stress on reading and math city-wide tests. I try to get kids working at their own level of potential. Those kids who are better tend to get pushed more.

Teachers' Perceptions of Themselves and Their Students

Rather than believing in the potential of all students, these teachers also made a distinction between stu-

dents who wanted to learn and those who they felt had basically given up or had no interest in learning. As one teacher phrased the problem:

> I've seen that there are some kids, some groups of kids, that no matter what you do to them, no matter how much you try to help them, they'll never want to accept the work, they'll never take it seriously. And you can spoon feed it to them, and they still won't retain anything, or if they do it's so temporary it's ridiculous.

Finally, in contrast to the other teachers in this study, these practitioners said that there had been no significant changes in their teaching practices. They started off teaching a certain way and they more or less maintained the same practices over time. When they spoke about change it was in terms of what they were required to teach or the students they were teaching. As one teacher explained:

> I've had to change what I expect of [my students]. If I have a bad class and I give them an exam and they don't do as well on the exam as I had hoped, I don't blame myself anymore.

Another teacher said:

> For the last seven years I've been in a Regents program and I feel I've become more of a high school teacher and it's more of a lecture. . . . I'm a very structured person and the kids will say, "You're too straight." I have a certain structure that I've always followed and that hasn't changed.

Teachers' Reluctance to Use Information Technologies

In part, these practitioners were reluctant to get involved with technology because they were afraid that it would disrupt their classroom practices. As one teacher stated:

> With 31 children it is not realistic to use computers. The kids who are working on the computer are missing the class lesson, and when am I supposed to make this up? All they do is play with the computer and miss class instruction. If they are playing, they are not learning. The computer is basically a disruption that doesn't really teach anything.

She felt that if computers were to be used at all it should be in the form of whole-group lessons in a lab setting.

Another teacher talked about her fear that computers would alter her relationship of authority to her students:

> I guess, basically, I'm afraid—I'm afraid that I'm going to make a mistake and the kids will have an upper hand. Kids who don't even have computers, they can go in, they can look at it, and all of a sudden [they get it]. I guess I'm trying to get it so perfect, and they're just doing it naturally.

In addition, the teachers in this group complained of a lack of time to get involved with computer technology. One teacher explained that he was responsible for five classes a day and it was virtually impossible for him to find the time to review software and figure out how to use it in relation to his curriculum. Similarly, another teacher said:

> I feel there's really no time for me to bring them to use computers. I just don't see any space for it. You're pressed for time to fulfill what you have to do and I don't have time for it.

Conceptualizing the Relationship Between Technology and Education

The conservative pedagogical beliefs that characterized this group appeared to influence how they thought in general about the relationship between technology and education. They did not share a vision of technology as deeply integrated into the curriculum. They were much more likely than the other teachers to suggest that the most productive relationship between technology and education existed when technology functioned to reinforce individual children's basic skills or to boost students' motivation. They tended to see technology as a "special treat"—an add-on to, rather than an enhancer of, the regular curriculum.

Envisioning Future Classroom Environments

Finally, in imagining an ideal teaching environment, a number of the themes that emerged in other segments of the interviews were reiterated. For example, one

teacher talked about wanting an "ideal group of kids," who

> follow all the instructions, and if you tell them to do homework they'll do homework. If you tell them there's a test on Friday, they'll study for the test. That's an ideal group of kids in my opinion.

These teachers also mentioned wanting bigger, more modern and more comfortable rooms, smaller classes, and less bureaucracy. Finally, two of these teachers said that in the future they would like to have microcomputers in their rooms. However, when asked what they would do with this technology, these teachers did not have clear ideas and seemed to be drawing an equation between "classroom of the future" and microcomputers.

Progressive Practice and Lack of Opportunity

Classroom Practices and Educational Objectives

There were two teachers who fell into this category: one was a fourth grade classroom teacher from the suburban district, and one taught science in the urban junior high school. In terms of their classroom practices and educational beliefs, they sounded very much like their colleagues in the other student-centered groups. The elementary teacher described how he ran his classroom:

> It's kind of like a forum. It's the concept of coming to a town meeting, examining a particular idea for the day, and tossing that around. And then there's a lot of support activities that go with it—hands-on activities like building something, or working in small groups to answer some question and report back to the large group. It's trying to reach conclusions and develop concepts.

The science teacher talked about her goals in similar terms:

> It's group activities—it's always group. ... It's really a collaboration. Everybody works together, everybody has a job, and it really works nicely. The kids take over the classroom—it's their room, not mine. It's fun. I like it, they love it.

Teachers' Perceptions of Themselves and Their Students

Like the other teachers whose beliefs and practices were student-centered, these practitioners also said that how they taught had changed over time:

> I don't see myself as a director anymore, it's more of a facilitator. Just to spark something when there seems to be kind of a lull, to push them a little farther, or to make them reach a little higher. A lot of this has to do with blind trust. A lot of it's been experience.
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> * * * * *
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> I like my kids to want to come into the room, I don't want to have to pull them in. So that's changed—a better relationship with the kids, more openness in the room. Experience is the best lesson.

Conceptualizing the Relationship Between Technology and Education

In general, these teachers looked favorably on the use of information technologies in education, and the classroom teacher had created his own library of videos, which he used extensively in his teaching. They had not been directly involved with using computers because of scheduling problems and a lack of available machines. As a result, they had a limited understanding of how technologies could be incorporated into their classroom work. As the science teacher said:

> I think in science computers should be more of a reinforcement than a learning-by-doing. Learning-by-doing in science is hands-on. I have not yet seen a program in science where the kids will learn and retain what the computer is showing them. I think it's more of let the teacher and let the classroom learn as a group, then let's go to the computer room and reinforce it.

The classroom teacher had similar ideas about the role that computers might play in his classroom:

> Computers are a very valuable assistant. It would be like having another pair of hands or an assistant in the room. I can see it as a tool for reinforcement. I could never give over totally and say, "O.K., I'm not going to teach you that so let the computer do it." I have a problem with that concept.

Envisioning Future Classroom Environments

However, when it came to imagining the kinds of ideal environments in which they would like to practice, these teachers generated an array of rich and inviting images. The classroom teacher said:

> The idea of planning a perfect classroom is like a dream come true. I can see where you'd have a carpeted area with steps so you'd have a kind of Greek forum. So, if we're talking it should be acoustically good, there would be carpeting and you'd be able to hear a pin drop. I would like to have an area of the room that was totally accessible for video so the kids could go down and sit in small groups in front of a screen, so that I could have six kids there doing one thing and have a talk group going on over here that wouldn't even know this was happening. And I'd have an area with computers that would have proper lighting and the proper kind of work station. And instead of rickety tables, they would have stations where they could store materials and be treated like this matters.

The science teacher described her ideal environment as follows:

> Very modern, very comfortable. Do away with these wooden desks and these wooden chairs. Colorful and bright, and computers are available, and little science corner labs, and little math centers. Clean running water. Maybe carpeted. I would design a classroom that would be like a home to me, where I would want to feel good. It would be cozy—when you're comfortable you're happy.

DISCUSSION

The findings of this study suggest that for the teachers we interviewed, there is a relationship between their educational goals and objectives and the ways in which they are able to integrate computer-based technologies into their ongoing classroom practices. Unless teachers are personally ambivalent about computers or have lacked the opportunity to get involved with computer technology, it appears that their educational beliefs play an important role in how they choose to appropriate and make use of technologies in their classrooms.

As practitioners, the high-tech teachers appear to be a highly motivated group, and the fact that they continue to perceive themselves as learners is no doubt an important motivational factor. These teachers wish to continue to grow and develop as professionals, and as a result they seek out new educational opportunities and innovations. They are secure and comfortable in their roles and are willing to learn from their students.

The high-tech teachers use their student-centered pedagogical beliefs to facilitate the effective integration of technology into their curricula. The teachers in this group make conscious and deliberate efforts to find applications that support the kinds of student-centered practices that prevail in their classrooms. Interestingly, these teachers also acknowledge that the technology has helped them to teach differently. Specifically, they have more time to help individual students, and in certain cases their teaching has taken on a new quality (e.g., more process-oriented than content-oriented). The technology has also helped them to implement desired educational practices such as small-group work and project-oriented activities.

The low-tech teachers in this study represent a more diverse group than the high-tech teachers, and the relationship between their pedagogical beliefs and their reluctance to get involved with information-based technologies poses a different set of issues.

Those teachers whose practices are also student-centered, but whose relationship to technology is at best ambivalent, appear to need certain kinds of support services that the high-tech teachers may have wanted when they were first learning about computers, but managed to do without. While these teachers, like those in the high-tech group, are also highly motivated individuals who perceive themselves as learners and are willing to develop and grow in relation to their students, their anxiety about computers prevents them from appropriating the technology. If they wish to overcome their fear, they need to experience the relevance of information technologies to the work they do in their classrooms and to other aspects of their professional and personal lives. Because they have a sense that they are now outside the technology cultures that have arisen in their schools, they need to be supported in their learning within the context of these cultures. These teachers need to have individuals who are available and willing to serve as personal informants and troubleshooters.

Similar support is needed by those teachers for whom access to technology has been the principal

obstacle to effective integration. Simply giving them machines is not enough. Like the other low-tech student-centered teachers, these individuals carry on their work apart from the technology cultures that have developed in their schools. While these teachers do not have to overcome a technological phobia, their interviews make it clear that they would need advice and support on how to integrate technology into their curricula so that it becomes much more than just an "add-on."

For teachers whose educational beliefs and practices are traditional, there exist different and much more complicated barriers for technology interpretation. In order to integrate technology into their curricula as the high-tech teachers have done, the very nature of their practices would have to change. In order to bring about such change, however, different layers of the educational system would have to be effected, ranging from changing how assessment is done to helping teachers rethink how students learn and develop.

The issues facing teachers who are not using technologies are different today than they were five or ten years ago. For large numbers of teachers, computers are no longer novel objects, and many schools already have in place sophisticated technology cultures (Sheingold & Hadley, 1990). If teachers want to use information technologies, then the kinds of support they need will undoubtedly be different from the kinds of support that were necessary in the past. How nonusers can be invited into these school-based technology cultures, and how their colleagues can serve as informants and instructors are issues that schools and districts will need to address. We recognize that the problems are complex and that there is not a single solution that will meet the needs of all teachers and all schools. Districts not only need to continue to commit resources (money and people) to their technology programs, they also need to adopt strategies that are flexible enough to meet the very different needs of very different teachers.

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